Agenda

- Introduction: Internet Quality of Experience Panel
  - Yves Chenet (Red Tech Consulting)
- TRA Bahrain Quality of Experience
  - Eric Dunand (TRA Bahrain)
- UAE-IX: Pursuing an efficient structure for the Internet in the Middle East
  - Lars-Erik Odman (Du)
- Microsoft: Quality of Experience for services
  - Cyril Voisin (Microsoft)
- Internet video Quality of Experience
  - Yves Chenet (Red Tech Consulting)
- Internet Exchange Point Construction
  - Bill Woodcock (Packet Clearing House)

Internet video Quality of Experience

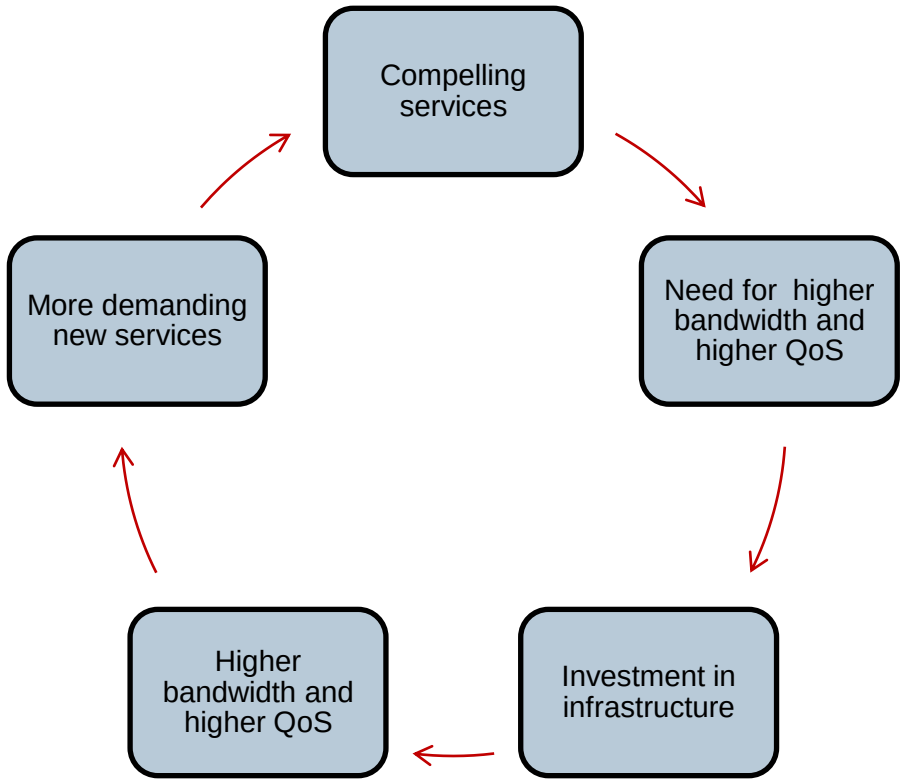
menog 10 conference, Dubai, 30 April, 2012

Yves Chenet, Red Tech Consulting

Need for better QoE has been one of the great drivers of the Internet services and infrastructure development

- Compelling services
  - E-mail: 2.172 billion users (1)
  - Web: 555 million websites (2)
  - Search: 50 billion indexed pages (3)
  - Social networks: 2.4 billion accounts (1)
- Massive investments by telecom operators:
  - 1990-2010: 4 trillion $ + (5)
  - Initial investment focus: mobile voice, core and international fiber: 300 million km fiber in 2000 (4)
  - Since 2000, major focus on broadband access:
    - Fixed broadband: 530 million subscribers in 2010 (5)
    - Of which: 67 million FTTH/B (179 million passed) (6)
    - Mobile broadband: 890 million subscribers (WCDMA: 3G, 3G+…) end of 2011 (7)
    - Of which : 6.7 million subs LTE (7)

Internet ecosystem innovation cycle

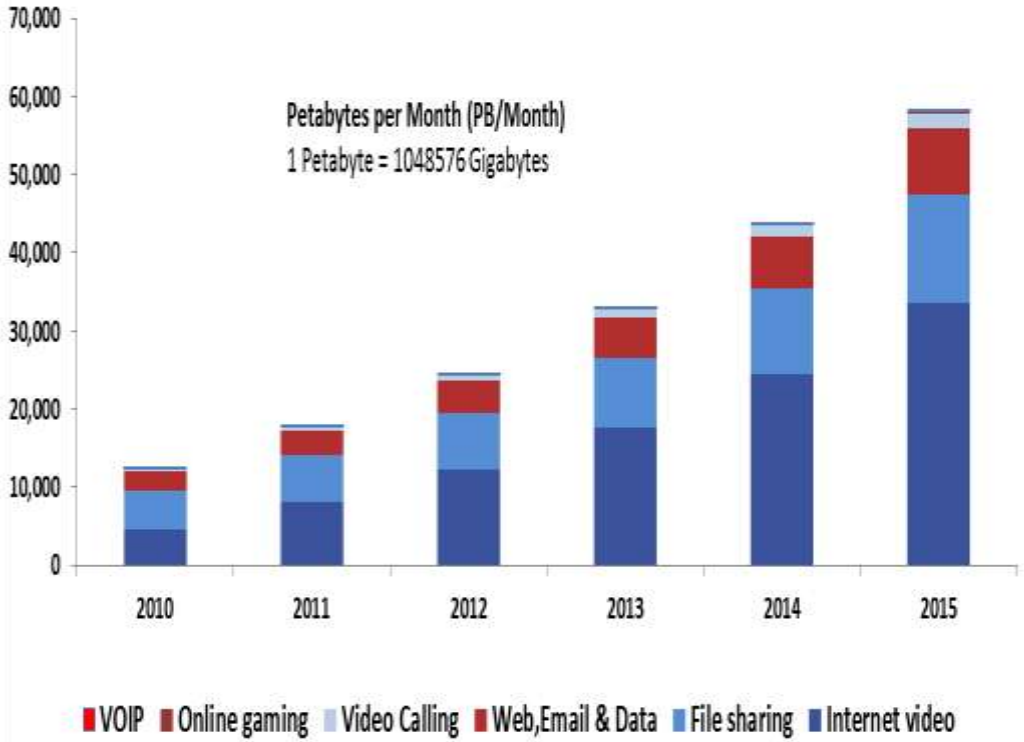


(1) Radicati group (2) Netcraft Jan 2012 (3) worldwidewbsize.com (4) Corning (5) ITU (6) Idate (7) GSAcom

The next compelling service is already here: Internet video

- Global Internet video traffic surpassed global peer-to-peer (P2P) traffic in 2010, and by 2012 Internet video will account for over 50% of consumer Internet traffic.
- It would take over 5 years to watch the amount of video that will cross global IP networks every second in 2015.
- Internet video is now 40% of consumer Internet traffic , and will reach 62% by the end of 2015.
- Video-on-demand traffic will triple by 2015.

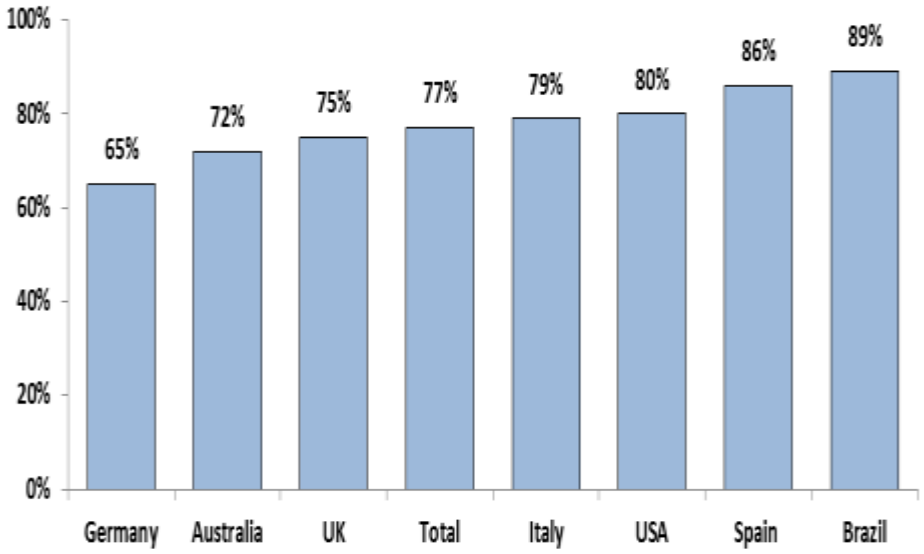
Global Internet Traffic forecast, 2010-2015 (1)



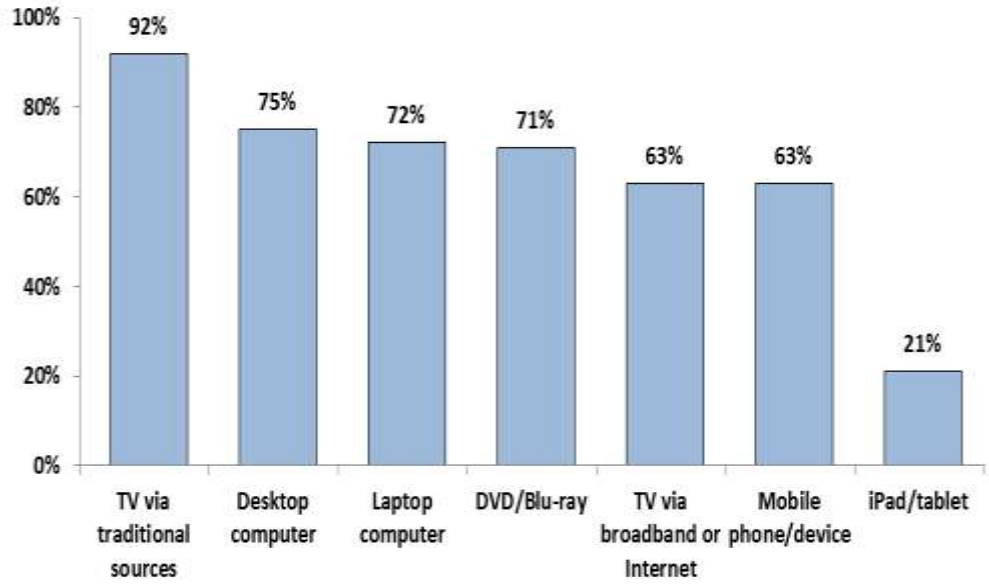
(1) Source: Cisco Visual Networking Index

Many Internet users watch video over the Internet and use many devices

% Internet users who watch video over the Internet in selected countries (1)



% Internet users who watch video – by device (1)



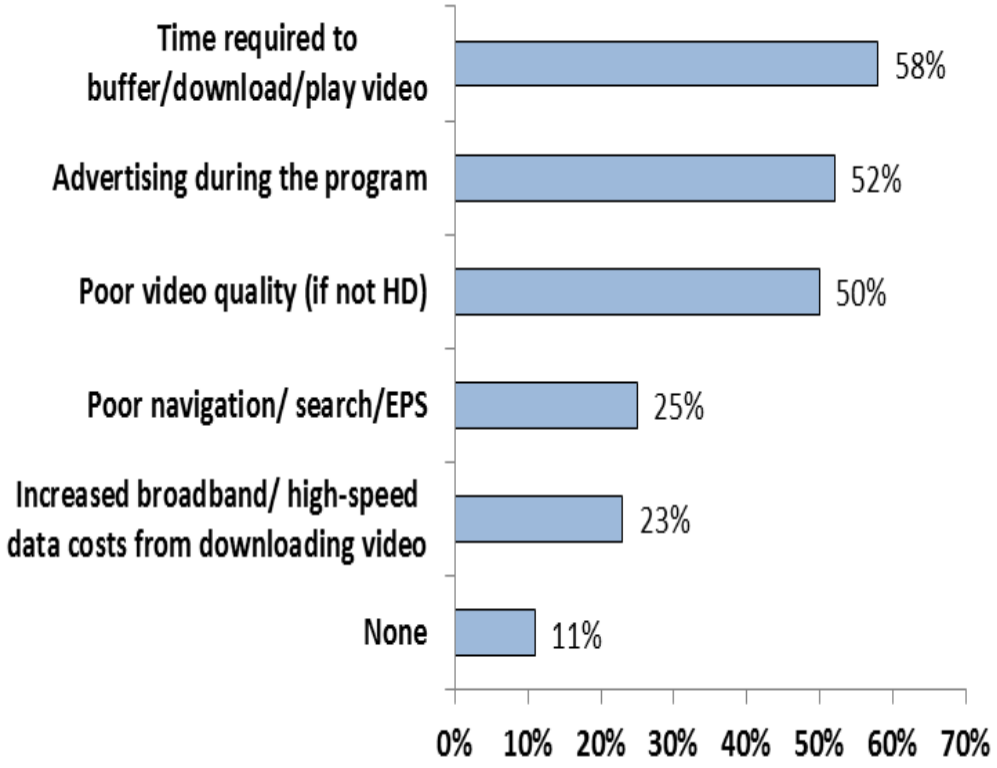
- 52% use PC to record TV content and watch it later
- 43% use catch-up TV to watch live TV on the PC
- 41% watch new channels which are not available on the TV
- 40% use video-on-demand

(1) 2011 Accenture Video-over-the-Internet Consumer Usage Survey. 6500 respondents

2 out of the top 3 frustrations about viewing Internet video are about Quality of Experience

- Reasons # 1 and #3 are related to Quality of Experience
- Reasons # 2 and #5 are related to the financing of the services and infrastructure

Frustrations about viewing Internet video on computer, TV and other devices (%) (1)



Time required to download/buffer/play video and poor video quality have the same cause: insufficient download bandwidth

(1) 2011 Accenture Video-over-the-Internet Consumer Usage Survey

Video codecs (coder/decoder) are used for video compression and decompression

- Most popular codecs:
  - H.264/MPEG-4 AVC or part 10
    - standardized by ITU and ISO
    - Included in HTML5
    - Used for Blu-Ray (one of 3 formats)
    - Supported by all browsers (IE, Chrome, Firefox)
    - Included in DivX v7, QuickTime, Msft Silverlight
    - YouTube opt-in trial HTML5
    - Used for visio-conference
  - On2 (VP6, VP7, VP8)
    - Used by Adobe Flash Player 8
    - VP8 made Opensource by Google
  - AVI and WMV
    - Developed by Microsoft
    - WMV9 also called VC-1: MPEG-4 variant
- Future codec:
  - H.265 or HEVC (high efficiency video coding)
    - For HDTV up to 7680*4320
    - Supports 3D

Uncompressed 1080p HDTV data rate

Pixel : 24-bit color

60 frames/s

# pixels	1980*1080	2,073,600
# bits per screen	2,073,600* 24	49,766,400 (16.7M colors)
# bits per second	49,766,400* 60 frames/s	2,985,984,000 bits/s: 3Gbits/s

Uncompressed HDTV requires

Gbits/s connections

H.264/MPEG-4 AVC or part 10 has become the Internet video codec standard

Since the video codec standard is defined, decision for the content or service providers will be to select the codec profiles to be used. Quality can be checked, but at the end, it will provided by the profile.

Some MPEG4 profiles (out of 21)

- Constrained Baseline Profile (CBP)
  - Videoconferencing and mobile applications.
- Main Profile (MP)
  - Standard-definition digital TV broadcasts that use the MPEG-4 format as defined in the DVB standard.
- Extended Profile (XP)
  - Intended as the streaming video profile, this profile has relatively high compression capability and some extra tricks for robustness to data losses and server stream switching.
- High Profile (HiP)
  - Primary profile for broadcast and disc storage applications, particularly for high-definition television applications (this is the profile adopted by the Blu-ray Disc storage format and the DVB HDTV broadcast service).

Objective video quality testing

- Full reference method:
  - Where the original video signal is available
  - Peak signal-to-noise ratio (PSNR). Requires same content and codec
  - ITU-T J.341 also called Vquad-HD (commercial name)

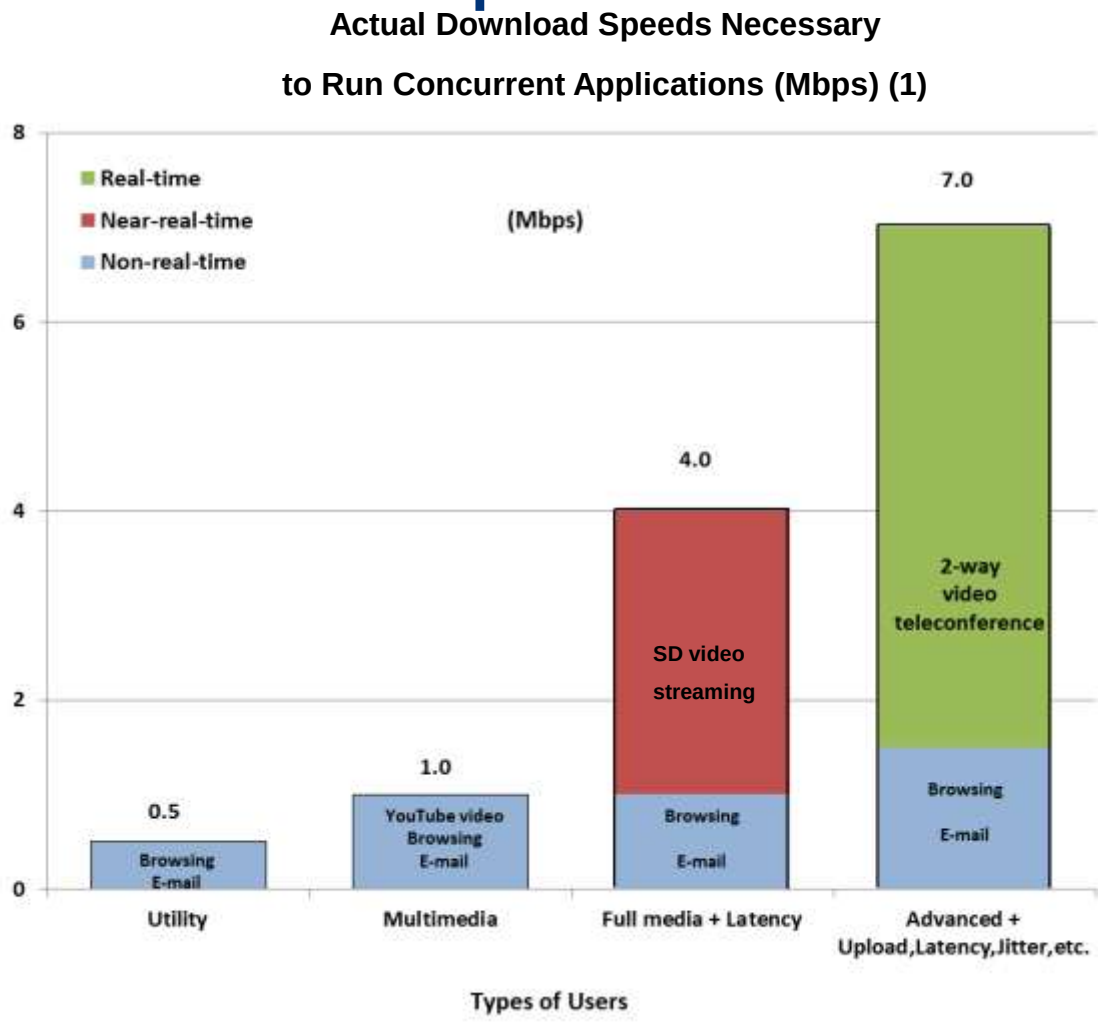
Subjective video quality testing

- Many ways described in ITU-R BT.500-11such as:
  - Double stimulus impairment scale (DSIS)
  - Double stimulus continuous quality scale
  - Stimulus comparison adjectival categorical judgment
- Short sequences used: 3 to 4 ten-second sequences

Profiles must be chosen taking into account network capabilities

The actual minimum download speed necessary to run advanced concurrent applications is 7Mbps

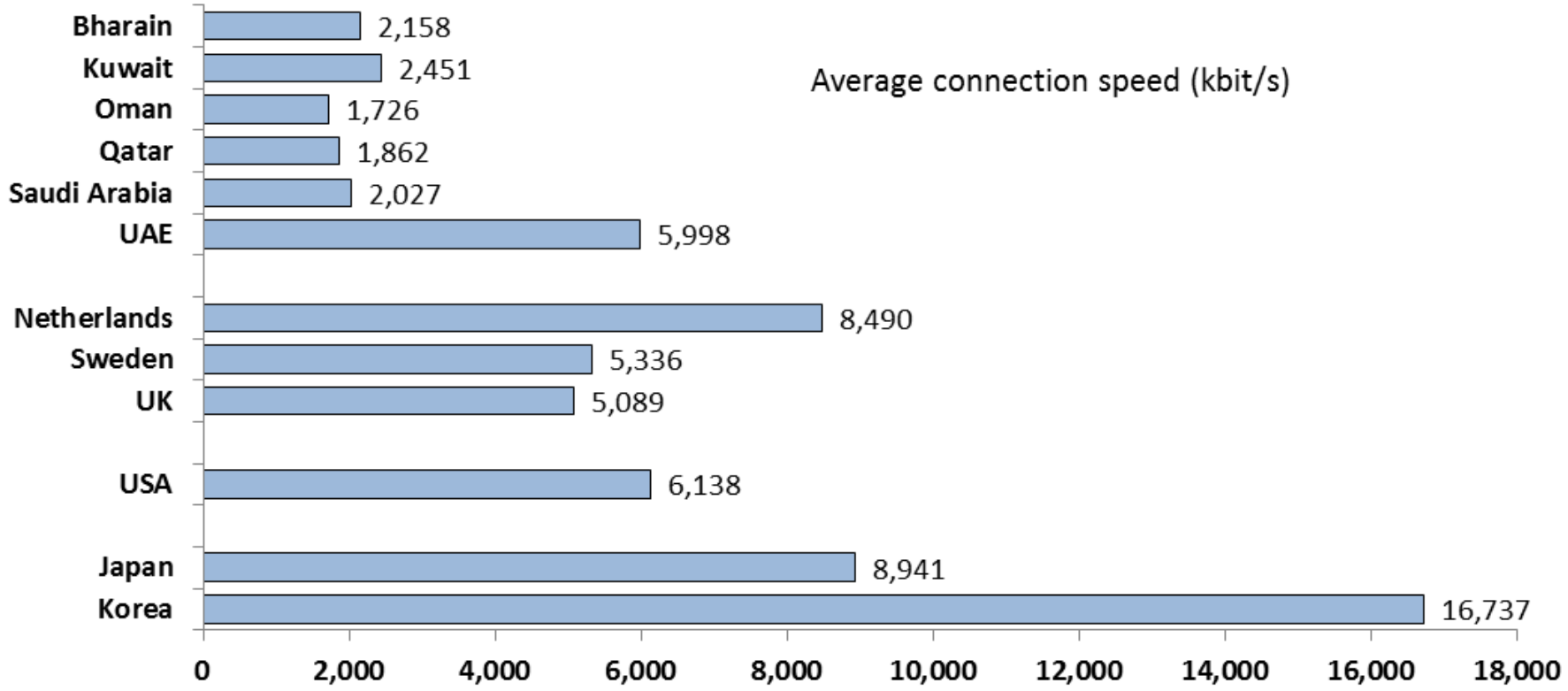
- TV VHS type of quality: 3 Mbps
- HDTV medium quality: 5.5 Mbps
- HDTV good quality: 20/25 Mbps
- iPad 3 screen: 2048*1536-pixel resolution



Video traffic growth will challenge networks in terms of latency, jitter, packet loss

(1) Federal Communication Commission | National broadband Plan

Based on FCC's segmentation, most of Internet users can already benefit from "utility" and "multimedia" services. "Full media" and "advanced" services are still reserved to few users in most of the countries.



Source: Akamai State of the Internet , Q3 2011

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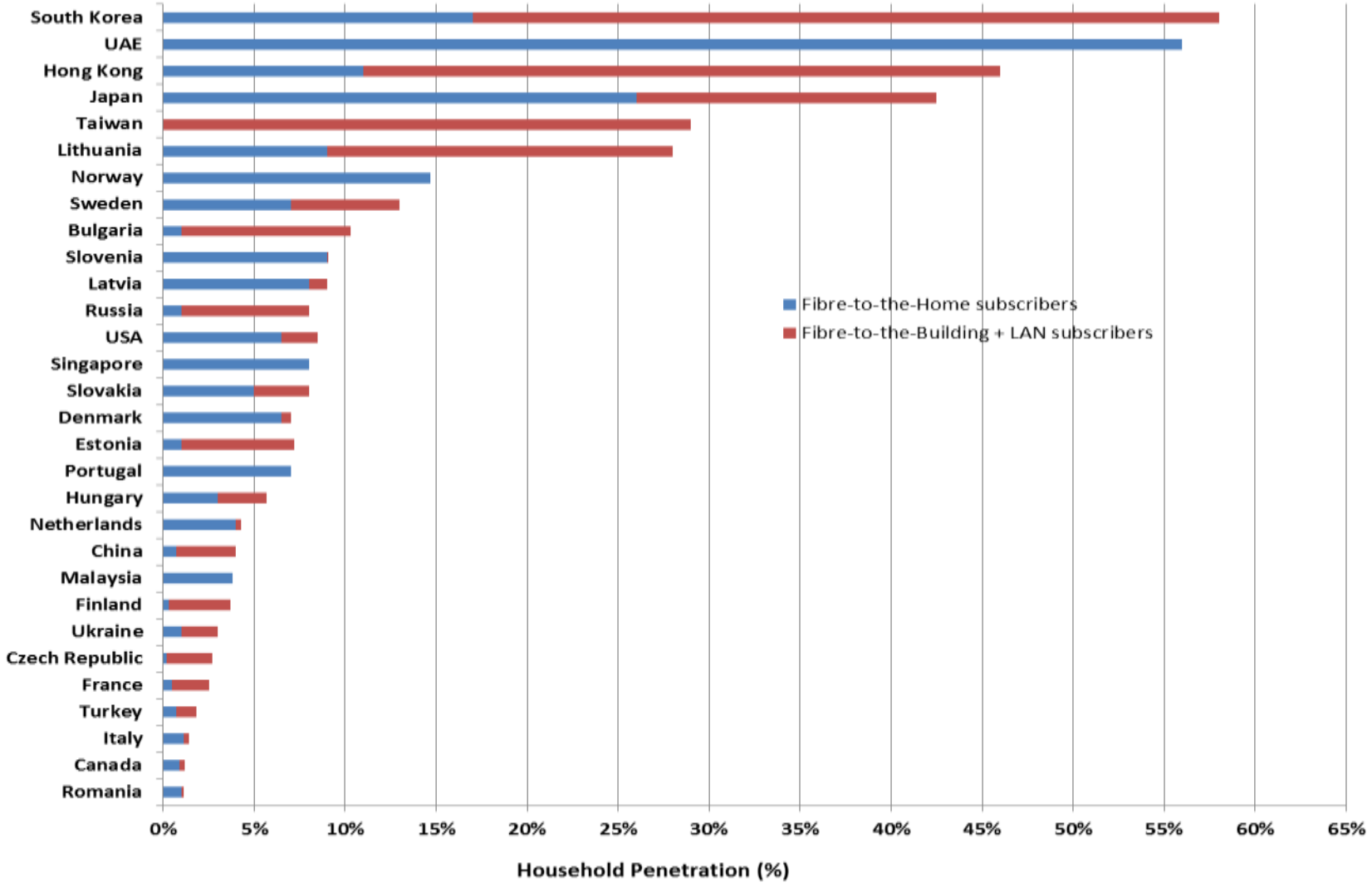
Back up slides

The UAE is now leading the world in terms of FTTH penetration



(1) Fibre-to-the-Home Council, February 2012

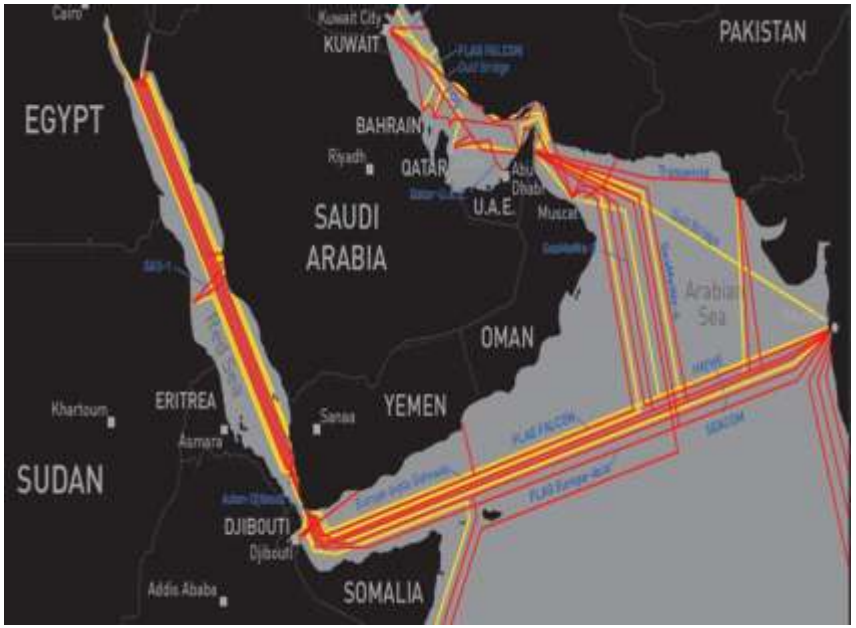
Operational and Upcoming Submarine Cable Systems around the Arabic Peninsula

Operational Submarine Cable Systems

Submarine cable system	Capacity in Tbit/s	RFS	Length (KM)
Flag Falcon	1.22	09/2006	10,300
Qatar-UAE Submarine cable system	0.02	12/2004	100
Saudi Arabia - Sudan -1 (SAS-1)	1.25	04/2003	333
FLAG Europe-Asia (FEA)	0.01	11/1997	28,000
IMEWE	3.75	12/2010	12,091
SeaMeWe-3	0.94	09/1999	39,000
SeaMeWe-4	1.25	12/2005	20,000
Fiber Optic Gulf (FOG)	0.005	06/1998	1,300
Europe India Gateway (EIG)	3.84	02/2011	15,000
SEACOM/Tata TGN-Eurasia	1.25	07/2009	15,000
The East African Marine System (TEAMS)	0.04	10/2009	4,900
Transworld (TW1)	1.25	06/2006	1,300
UAE-Iran	0.002	1992	170
TATA TGN-Gulf	1.28	11/2011	4,469
Kuwait – Iran	0.47	06/2005	380
Aden – Djibouti	0.02	1994	266
Gulf Bridge International Cable System (GBICS)	2.56	2012	13,000
Saudi Arabia - Sudan -2 (SAS-2)	0.006	2011	330
Total	**19.163**		

Upcoming Submarine Cable Systems

Submarine cable system	Capacity (Tbit/s)	RFS	Length (KM)
Middle East North Africa (MENA) Cable System	5.76	Q4 2012	8,000
Pishgaman Oman Iran (POI) Network	-	2012	-
Total	**5.76**		



Red Tech Consulting

(1) Telegeography, April 2012, (2)www.submarinecablemap.com

Net neutrality

- Video will represent a huge part of the traffic of operators
- Congestion mechanisms
- Net neutrality rulings
- Berec recognized that many EU countries block peer-to-peer and VoIP
- US: ruling on net neutrality
- How to make sure the market continues its development and that everybody benefits fairly